



Weinberg & Associates

Requirements for At-Source Herb Milling in Africa with Special Focus on Lemongrass

Report Produced for

Export Promotion of Organic Products from Africa
EPOPA

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with Special Focus on Lemongrass
For EPOPA

Background

Report titled *Report on Lemongrass and its Potential in USA* was completed for EPOPA by Weinberg & Associates in June 2004. In this report, we concluded that it was unlikely for the Zambian producers to build an export business based on exporting whole dried lemongrass, due to the competitiveness of the global supply, and subsequent low market prices. The current report explores a value-added strategy: milling of lemongrass into finished tea-cut product in Zambia.

Infrastructure required for milling lemongrass and other dried herbs

This report provides a perspective on the requirements of establishing a basic milling line for lemongrass and other dried herbs. We will describe equipment needed with further information on configuration, functionality and costs. Within the scope of this document we have not elaborated on basic requirements for a suitable building, access to electricity, incoming and outgoing transportation etc. While important and necessary components, these are better addressed with solid basis in the local and regional scene.

We describe a production line with the potential to meet both the volume and quality requirements necessary to become a viable player in a global market. The section entitled Appropriate Technology Alternatives discusses smaller scale, lower cost solutions.

Lemongrass Milling Challenges

Lemongrass (*Cymbopogon citratus*) presents milling challenges. It is very tough and fibrous, and the fiber structure is longitudinal. With the market for dried lemongrass being perhaps 90% for tea-bag packers using high-speed teabagging machines, a “flowable” product is required. Long fibers present in the finished product can cause “bridging” in the teabag machines’ feed channels, causing unwanted downtime at best, or rejected product at worst.

A second challenge in milling lemongrass is excess production of powder. As fiber length is reduced, the mechanical action of the cutter can pulverize the non-fibrous components of the leaf. Particle sizes less than 60 to 70 mesh (250 to 210 microns) will migrate through teabag papers, and are therefore unacceptable in the finished product. Percentage of powder loss tends to be higher in lemongrass than in most other herbs. This said, taking the inevitable powder losses at the source, when the raw product cost is low, and before additional value is added in shipping and handling, can be seen as a competitive advantage. Nonetheless, powder losses should be monitored and efforts made should be to reduce powder production.

To overcome these challenges, lemongrass requires special equipment. Precision cutting equipment with sharp blades and proper adjustment is required to assure the herb is cut rather than fractured. In addition, special length grading equipment is required to remove oversize fibers from the product.



Milling of Dried Lemongrass

The following information describes a herb milling line which could be used of milling many different herbal products. This configuration would be ideal for lemongrass, and special notations are made to specific lemongrass milling issues. See Figure A for schematic representation.

HARVEST

- The herbs are harvested at the optimal point of maturity, and at a time of day when any dew or moisture has evaporated. To the extent possible, it is best to harvest only the parts of the plant which will be in the finished product, and leave bi-product in the field. Care must be taken to reduce dirt, dust or other potential sources of contamination at every step of handling, beginning with harvest.

WASH

- Certain herbs are washed after harvest, others are not.
 - Lemongrass is typically not washed, unless needed to reduce dust or other contamination.

DRY

- The herbs are dried as quickly as possible, but without excess heat that will drive off the volatiles. Care must be taken to minimize contamination and mold during the drying process. Simple moisture testing equipment can be used to assure herbs are dried to the correct percent moisture. Drying has the important function of stabilizing the product until milling can be done.
 - Lemongrass is often cut and left in the field to dry in arid climates during dry seasons. Other possibilities are to dry under cover with or without a forced air fan, using solar or other energy sources for heat. Overheating in drying must be avoided, as volatiles tend to be diminished.

STORAGE

- Herbs are stored in whole form, again taking care to avoid contamination. Finished product storage is also necessary, where proximity to loading dock and truck access aids in efficient loading for shipment. Temperature and humidity control in the warehouse is a benefit. Control of rodents and other vermin is essential.

MAGNETS

- Rock traps and strong magnets should be installed ahead of the cutter in order to avoid damage to the blades and contamination of the product.

CUTTER

- Since field-run lemongrass stalks may be up to a meter in length, pre-cutting into intermediate lengths may be advisable. This may be accomplished with common farm chopping equipment.
- In the next step of milling, herbs are conveyed or hand fed into a cutter. An extra set of hard steel cutting knives is recommended in order to rotate sharpening and maintenance, and assure a fresh set of knives is always available.
 - For lemongrass, which has very tough, longitudinal fibers, a precision cutter is needed.



CONVEYORS

- Product conveyors are generally installed to automatically move the product from the outlet of one machine to the inlet of another. Conveyors should be installed with designed-in flexibility, since different configurations will be needed for different results. Mechanical elevators, bucket conveyors, flat conveyors and augers all may be used, with certain applications more appropriate to specific milling situations. Air conveyance equipment can be a good, albeit more expensive, conveying solution. And of course, the mill should be designed to work as much as possible with gravity, rather than against it. The location where the whole product enters the system, usually the cutter, is often located on a second or third story of the building.

SIFTER (SIZE GRADER)

- Next the product is conveyed to a sifter or size grader, which is a set of vibrating screens with precise square (or sometimes round or other shape) holes. A number of screens are stacked and particles travel down until they will not pass thru the next smaller screen. The machine has several outlets, one for each of the uniform sized fractions.
 - Even with a precision cutter, long fibers of lemongrass (known as “divers”) are usually present and tend to up-end and travel down thru the screens of the sifter. These are not desired in the finished product, so these fractions must now go to length graders.

LENGTH GRADER (INDENTS)

- Length graders, also known as indents, are rotating cylindrical drums or discs, whose interior is covered with uniform precision-sized concave hemispheric pockets. Particles that fall into the pockets come out one outlet, while the longer divers or stems which bridge the tops of the pockets come out another outlet.
 - Length graders are essential for milling of lemongrass, especially if the finished product will be used in teabag machines, where long fibers can cause “bridging”, ie block the flow of the herb thru the machines.

DUST COLLECTION

- Dust collection equipment is typically installed to collect fine airborne powder produced by from the cutter, sifter and length grader. This is made up of air suction equipment and a dust collector. As substantial quantities of dust are generating in the milling operation, adequate dust collection makes the work area safer and more pleasant for the workers.

WEIGHING AND PACKAGING

- The final stage in the milling line is the weighing and packaging station. Finished product meeting size specifications is collected from mill outlets in sacks, boxes or fiber drums. The containers are adjusted to a standard weight, and sealed. If sacks are used, tops are sewn with an electric bag sewer or by hand. Scales should be checked and calibrated against standard test weights daily. Digital scales or mechanical scales with over/under indicator are helpful. Sacks can be of multi-wall paper, of woven polypropylene or other materials.
 - For products with high volatile oil content such as lemongrass, it is advisable to choose bags with a liner or other barrier to slow the loss of volatiles in storage, and reduce uptake of moisture from the air, thereby increasing the shelf life of the finished product.



LOT TRACKING

- For organic production, a lot tracking system is required from field to finished product in order to maintain the organic audit trail.

TEST EQUIPMENT

- Simple in-house test equipment is relatively inexpensive and enables the operator to calibrate the milling equipment and assure the finished product meets customer specification.
 - TEST SIEVES a set of small brass test sieves of various sizes are used for determining particle size of intermediate and finished product.
 - A GRAM SCALE is used in conjunction with the test sieves to determine percentage of finished product in various size classes.
 - MOISTURE TESTING EQUIPMENT is a valuable on sight-tool for determining the moisture content and therefore the stability, of herbal products.
 - A GRADUATED CYLINDER is used in conjunction with the gram scale to measure finished product density. Density is often an important specification for teabag manufacturers, as teabag fill volume must make minimum declared weight.

OUTSIDE LABORATORY

- In addition to simple in-house testing, the services of an outside laboratory are required for testing for microbiological specifications (yeast, mold, bacteria), ash content, essential oils, residue analysis and other tests as required by the customer specifications.



Lemongrass specifications

Following are elements which might be expected of a typical specification for lemongrass teabag cut, for a leading US manufacturer. Exact customer specification should be obtained before production is begun.

Moisture:	less than 11%	
Sieve size:	on a #10 mesh (2000 microns)	0%
	on a #16 mesh (1190 microns)	<1%
	through a #70 mesh (210 microns)	<3%
	though a #120 mesh (125 microns)	<1%
Color		characteristic
Volatile oil	minimum	0.9%
	target	1.8%
Contaminants of Animal Origin		
	Excreta	none
	Feathers	<1 per kg
	Rodent hairs	<3 per 50 gram sample
	Animal parts	none
	Filth	<1%
Insect infestation		
	Live insects	none
	Dead whole storage insects	none
	Dead whole field insects	<20 per 10 gram sample
	Fragments	<100 per 10 gram sample
	Insect damage	<8% damaged pieces by weight
Adulterants of Plant Origin		
	Extraneous plant parts	<1%
	Non-toxic foreign plants	<1%
	Toxic plant parts	none
Adulterants of Mineral Origin		
	Heavy metal content	<10 ppm
	Lead	<1 ppm
	Mercury	<1 ppm
	Cadmium	<1 ppm
	Arsenic	<1 ppm
	Ash	<5%
	Acid insoluble ash	<1%
	Glass or metal	none
	Paper, string, cloth, plastic	<1%
Microbiological		
	Aflatoxins	<20 ppb
	Mold & yeast	<100,000 cfu per gram
	Standard plate count	<1,000,000 cfu per gram
	E. Coli	<200 mpn per gram
	Salmonella	none
Chemicals		
	Sterilants	no residue



Diversification Strategies

Beyond Lemongrass

Any expenditure of capital in processing infrastructure is amortized by using the equipment in production of saleable products. The more the equipment is utilized, the better the investment will pay off.

The processing plant described above will have the capability to mill many herbal products including, but not limited to lemongrass. Investigation should be made into other herbs of the region with commercial potential, either cultivated or procured in the wild. Not only will this better utilize the investment, but it will tend to keep people employed for longer periods, offer more market breadth, and provide needed diversification for the enterprise.

While organic production may be the central focus of the mill and this development project, flexibility to also mill herbs which are not organic should be considered as a means to expand opportunities for utilization of the mill and expansion of sales. In this case rigorous clean-up protocols must be developed and implemented.

Costs of Establishment

Accurate estimation of mill establishment cost is not possible without intimate knowledge of in-country costs, and important decision making on the part of management. Costs will vary depending on existence and quality of existing infrastructure such as building, energy source, transportation and availability of local skilled labor for fabrication and installation.

Figure B includes benchmarks of cost of equipment, providing prices if purchased new in the USA. No estimate has been added for shipping or installation. It is important to note that there is a wide range of equipment that is suitable to perform each milling function. Decisions to purchase used vs. new equipment can reduce costs by 65% or more, (but may increase maintenance costs and down-time). On-site fabrication of certain pieces of equipment, especially for less technical equipment such as conveyors or dust collectors, can further reduce costs and also avoid equipment shipping costs.

Appropriate Technology Alternatives

The perspective we have taken in this report is to describe a milling line which would be capable of producing herbs in quantity and of quality for a realistic entry into the global herb market.

Matching the scale of the enterprise with capital investment and market niche are critical to the success of any enterprise. If the aspirations for this project or the availability of capital do not warrant investment in a milling line such as the one described above, there are other lower cost "cottage industry" approaches that may be taken. Describing these are beyond the scope of this report and outside the expertise of Weinberg & Associates.

Please see reference to Intermediate Technology Development Group in the Resources for Further Information section of this document. ITDG has produced a series of Technical Briefs with descriptions of low cost, appropriate technologies. While these may not be of much practical use due to their oversimplification, they nonetheless provide interesting insight into cottage industry technologies apparently in use around the developing world.



In addition to milling of dried herbs, other value-added strategies could be considered: ie production of essential oils, soaps, candles etc. In each case, financial analysis must be undertaken to assess ability to meet the producer's objectives and at the same time fulfill a market need.

Further, we recommend that EPOPA undertake a survey of similar development projects of other groups, and set up a program of information exchange to learn from their experiences. For instance, we are aware of a project in neighboring Malawi called Pirimiti, who claims to have been involved in organic herb production since 1996, producing and exporting dried herbs including lemongrass, hibiscus and birds eye chilies, plus sesame and sunflower as oil crops. The project's owner, Arthur Stevens, purports to offer consultancy services to other interested organic producers in production, processing, packaging and marketing.

Conclusion

For a modest investment, a line of equipment can be set-up to produce lemongrass and other herbs suitable for sale in the global herb market. We have described the equipment required and indicated benchmark costs of new equipment.

These capital equipment costs are only one factor of a more comprehensive profit and loss projection that such an enterprise would require. If initial outlook is positive, we recommend preparation of a more robust business plan in order to more fully assess the viability of the enterprise.



Resources for Further Information

Intermediate Technology Development Group

East Africa Office
P.O. Box 39493
AAYMCA Building (Second Floor)
Along State House Crescent
Off State House Avenue
Nairobi, Kenya
www.itdg.org

ITDG Technical Briefs

- [Small-Scale Drying Technologies](#)
- [Small-Scale Spice Processing](#)
- [Food Processing Building Design](#)
- [Food Processing Equipment Design](#)
- [Quality Control in Food Processing Businesses](#)

Pirimiti Trading Services Limited

161 Zomba, Malawi
pirimiti@malawi.net

Sieve Conversion Chart (US Standard Mesh-inches-metric)

<http://www.reade.com/rfq/meshpop.shtml>

SELECTED EQUIPMENT MANUFACTURERS

Cutters

- S. Howes www.showes.com

Sifters

- Sweco www.sweco.com
- Rotex www.rotex.com
- Great Western Mfg www.gwmfg.com

Length Graders

- Carter Day www.carterday.com
- Ideal Grain & Seed

Milling Line for Lemongrass

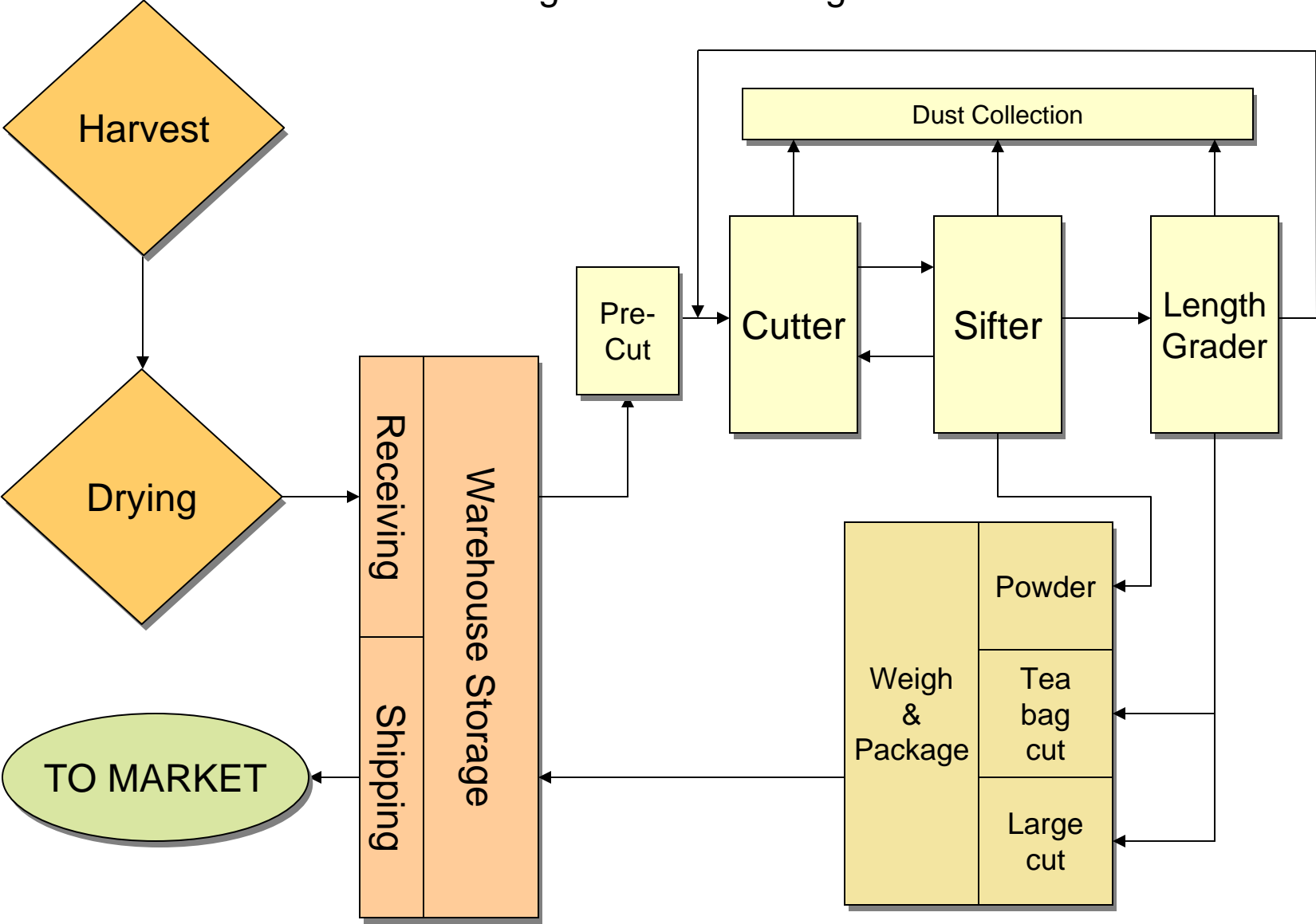


Figure A

COSTS OF NEW MILLING EQUIPMENT

FIGURE B

000's

EQUIPMENT	APPROX COST USD
PRE-CUTTER	\$5
CUTTER	\$15
SIFTER	\$30
LENGTH GRADER	\$10
CONVEYING EQUIPMENT	\$5
DUST COLLECTION	\$6
WEIGHING & SEWING	\$2
TEST EQUIPMENT	\$2
TOTAL NEW EQUIPMENT	\$75

OTHER COSTS TO BE DETERMINED

EQUIPMENT SHIPPING
INSTALLATION & FABRICATION
FORKLIFTS - PALLET JACKS
PALLETS AND RACKING
BUILDING CONSTRUCTION OR MODIFICATION
ELECTRICAL SERVICE
DRIER COSTS

NOTES:

New equipment based on US prices

Shipping & installation not included